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Using Transects to Understand Cyanobacterial Blooms

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Using transects to understand cyanobacterial blooms

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Overview

- Toxic algae (and cyanobacteria) are a game changer
- Might have to revisit our objectives and goals
- Need to consider wider range of management approaches
- This talk focuses on short-term mitigation
  - Monitoring
  - Possible approaches

Two hypotheses for addressing blooms in UKL and Agency Lake

- TMDL
- Reduce P loading
- Will reduce algae in general
- Long term / large spatial scale

- Humic Hypothesis
- Restore wetlands
- Marsh water will limit APFA growth
- Seasonal and near-shore scale of impact

Two hypotheses for addressing blooms in UKL and Agency Lake

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- Restore wetlands
- Marsh water will limit APFA growth
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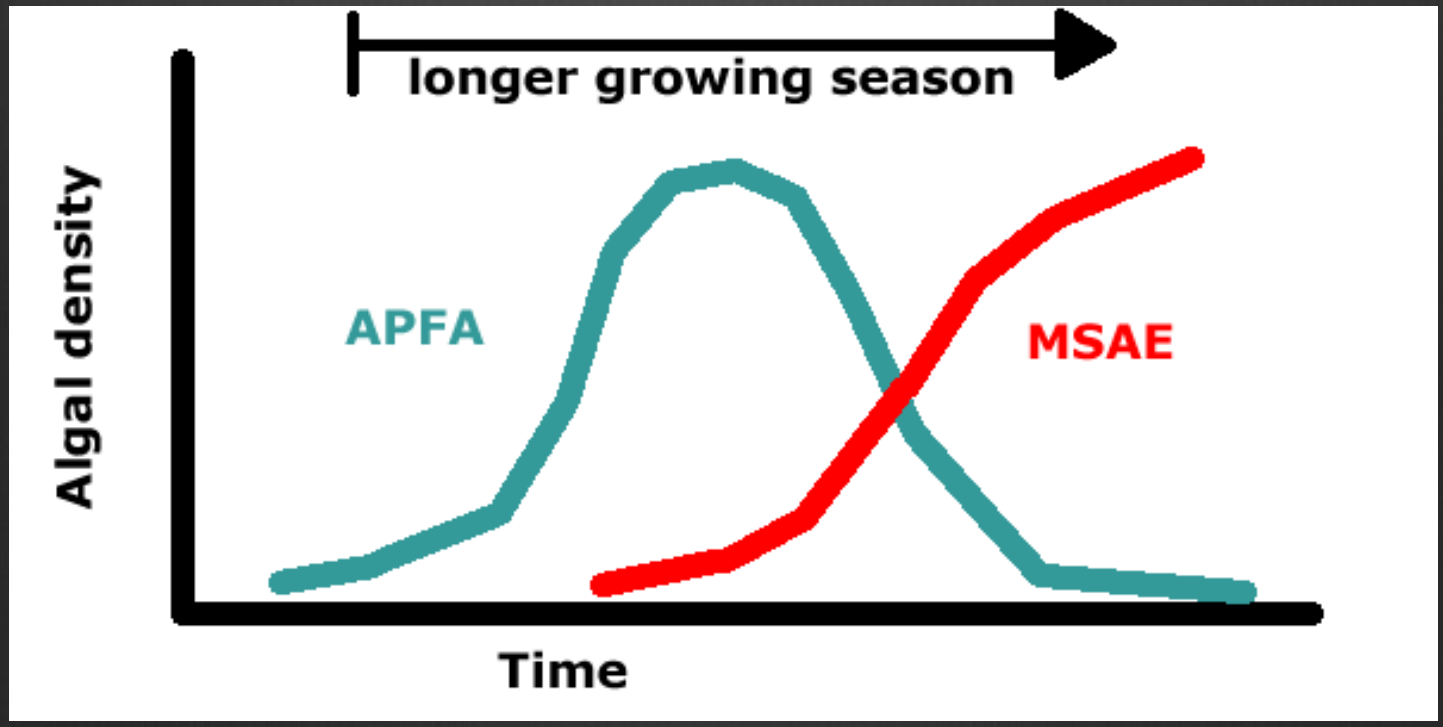
Neither of these address the impact of increased frequency and spatial distribution of toxic strains.

Need to have more specific objectives

- "Harmful Algal Bloom"
- What's a bloom?
  - Wikipedia – "increase or accumulation"
  - NOAA – HABS is when they "grow our of control"
  - EPA – HABS occur when there is "overgrowths of algae"

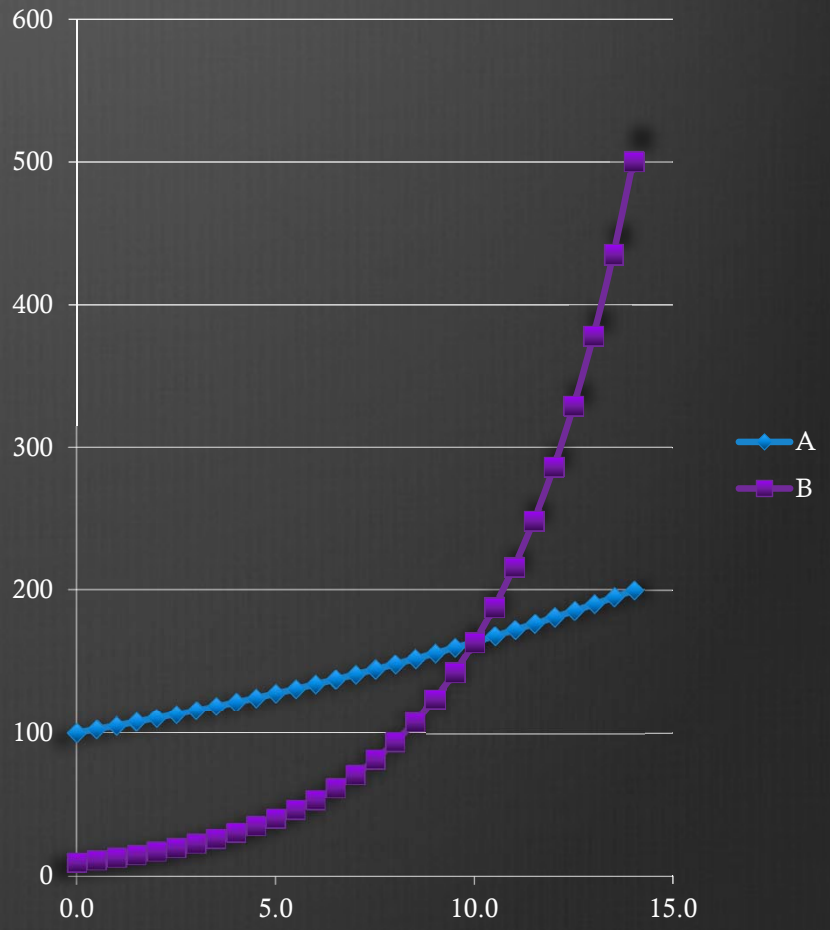
Algal growth

- Succession – takes months



Algal growth

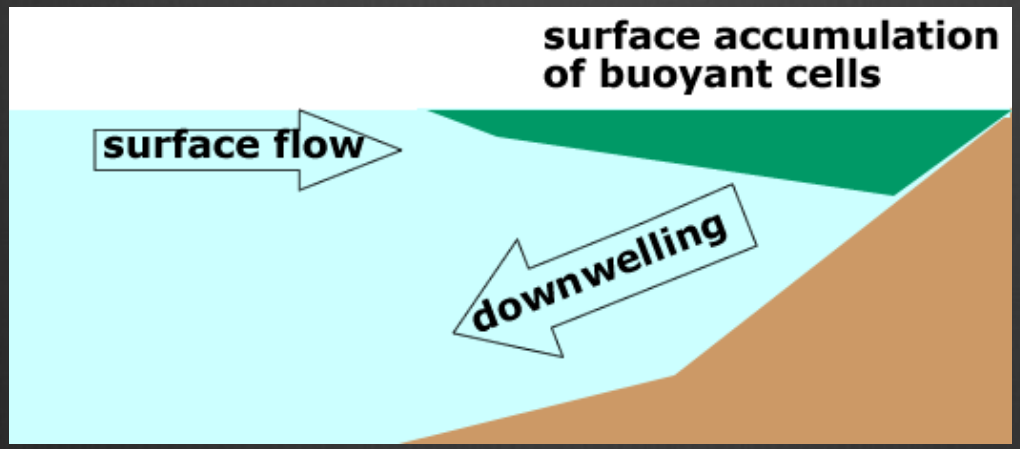
- Succession
- Competitive Exclusion - takes weeks



Example:
B is growing 2x as fast as A (.5 vs .2.5)
Loss term is same for both (-.2)
A starts at 100, B starts at 10
B takes 10 days to exceed A

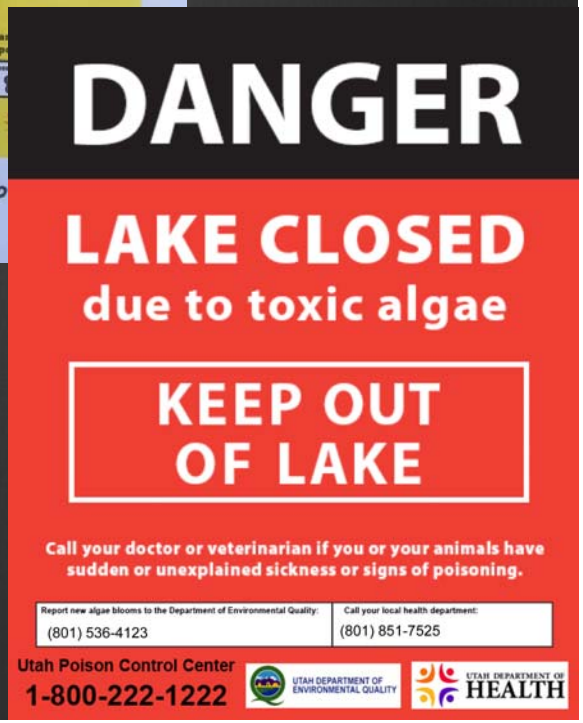
Algal growth

- Succession
- Competitive Exclusion
- Accumulation of buoyant algae – can happen in a day



Management

- Solution – remove the drivers
- Resilience or resistance
- Mitigation
- Risk Management
- Adaptation to future weather



Scientific Adaptive Management

- Manipulations are experiments
- Multi-scalar
- Place sensitive (landscape includes humans)

Norton 2005

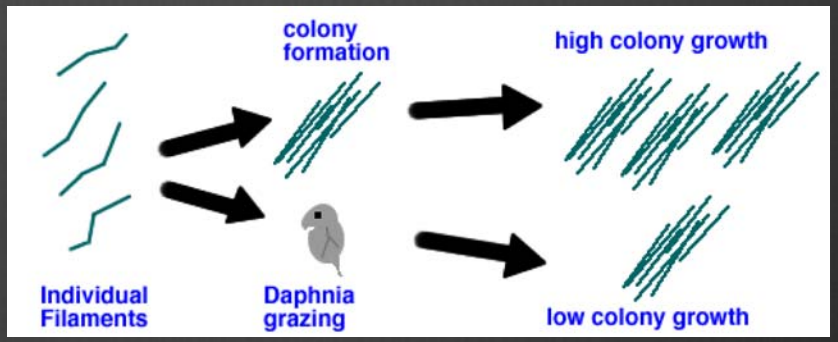
Scientific Adaptive Management

- Manipulations are experiments
- Multi-scalar
- Place sensitive (landscape includes humans)

Use SAM to explore mitigations that are hypothesized to reduce impact of toxic algae.

Example 1: use marshwater to suppress APFA

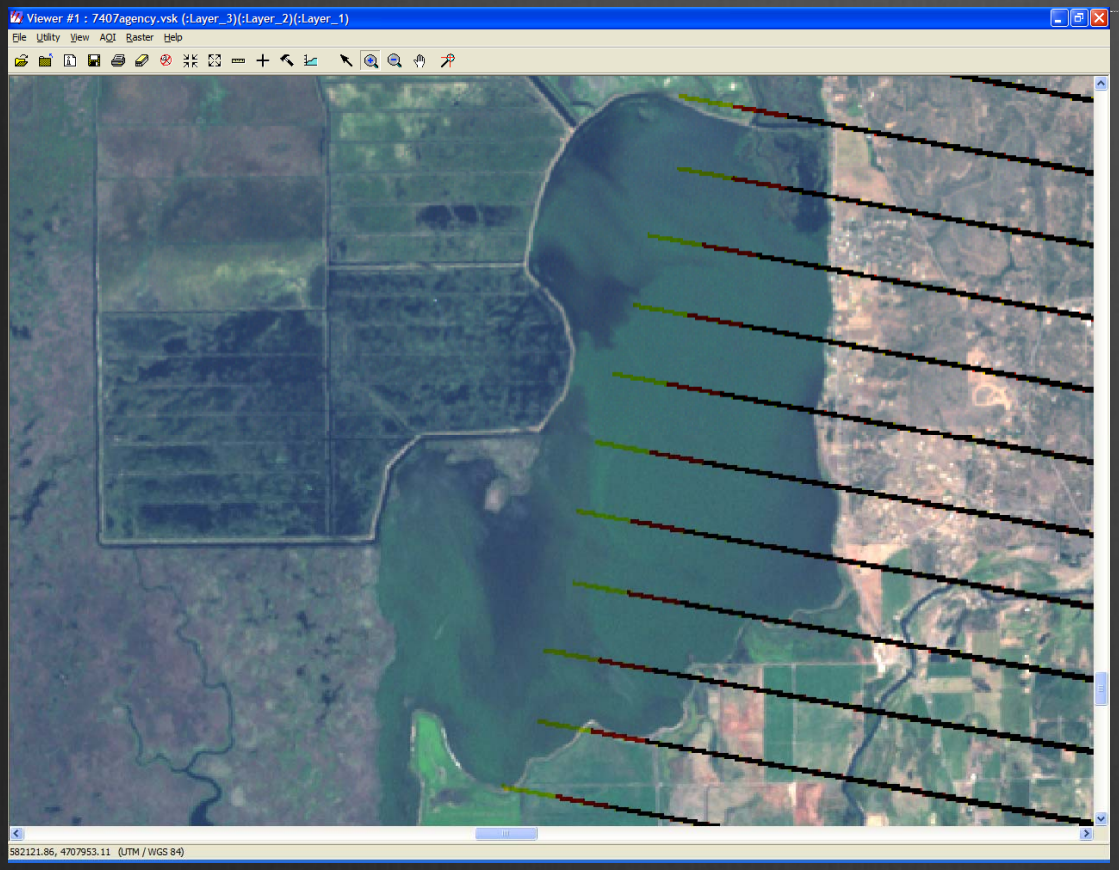
- Observations around marshes that there is
- Suppression of growth early in the season can minimize a bloom (and possible crash) later



- Mechanism
  - Something to do with humics/brown water
  - Benchtop studies are ambiguous
  - Mesocosm – recent work by Rouhe points to ions
- In-lake measurements

Opportunity and Approach

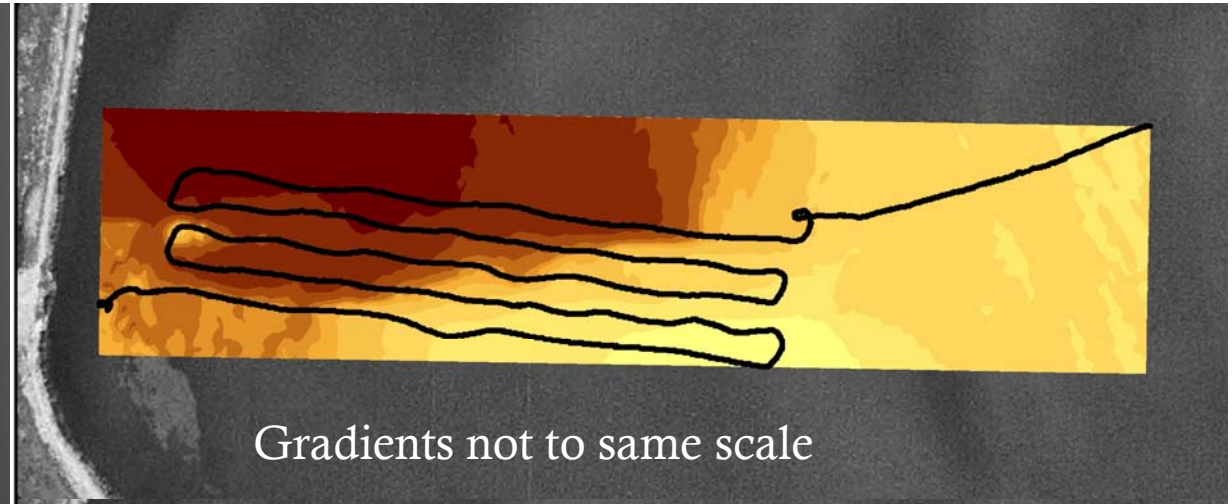
Agency Lake Ranch water storage and pumping into the lake



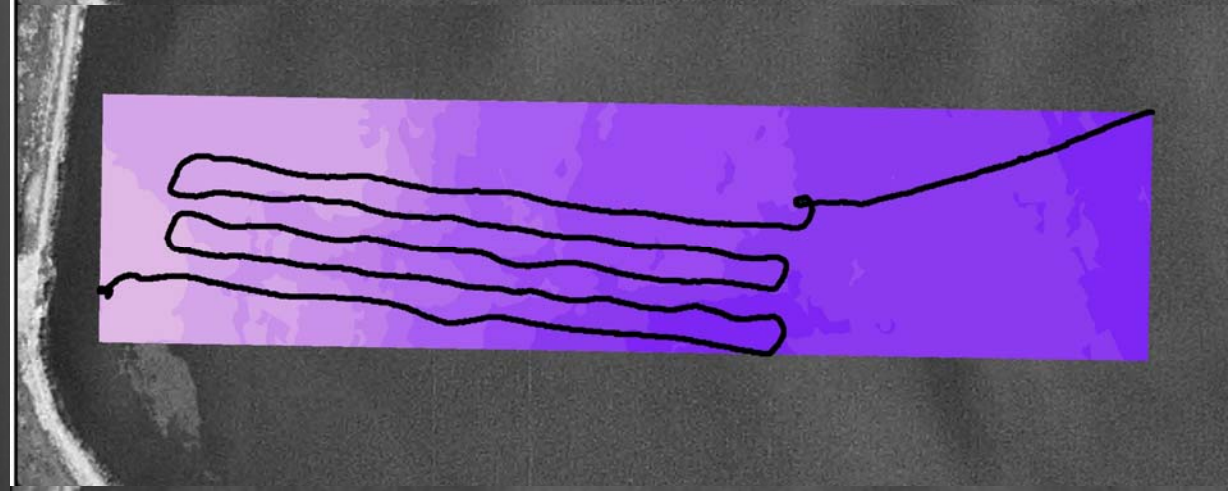
Transect device

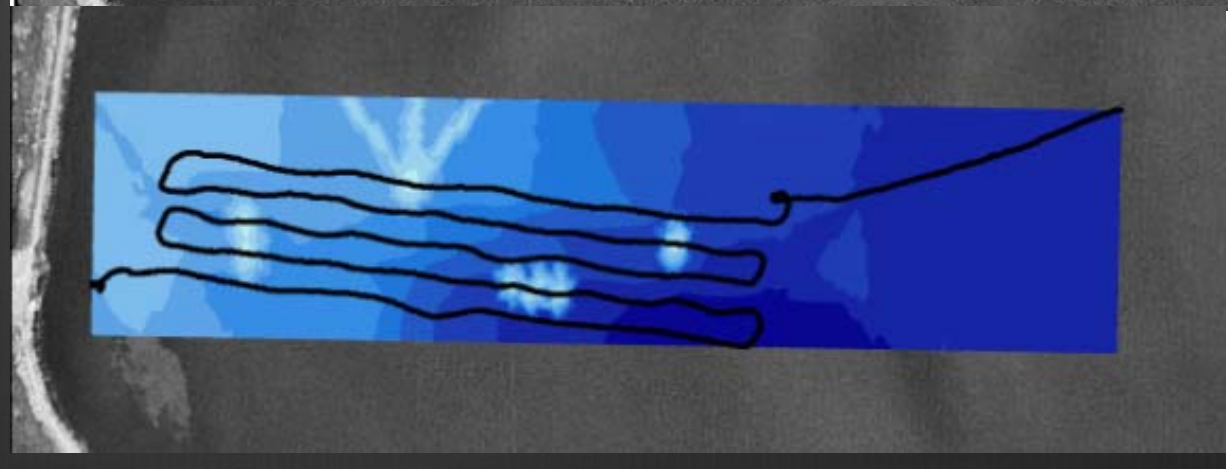
Transects when the pump is on

- CDOM
- Phycocyanin
- DO



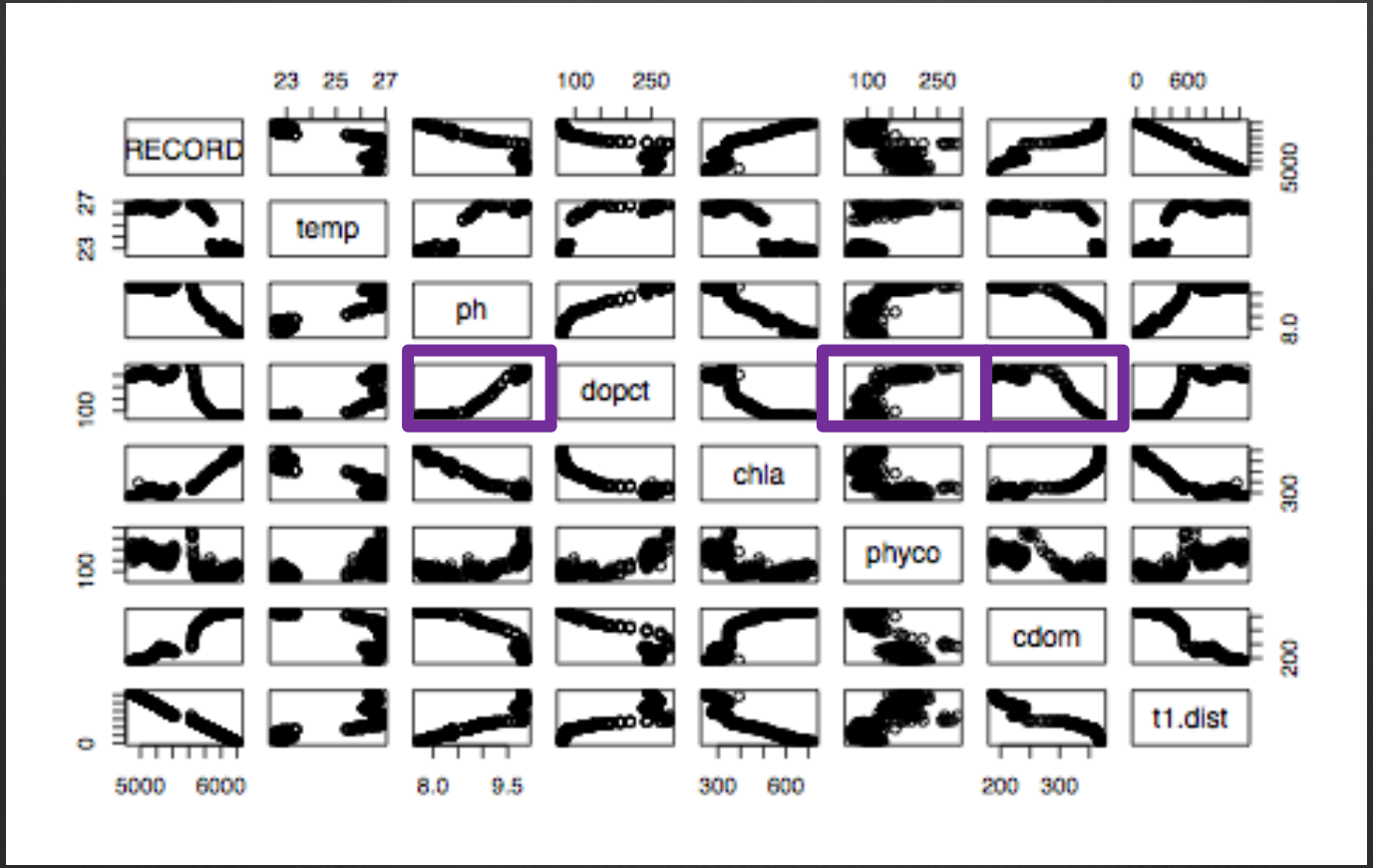
Gradients not to same scale





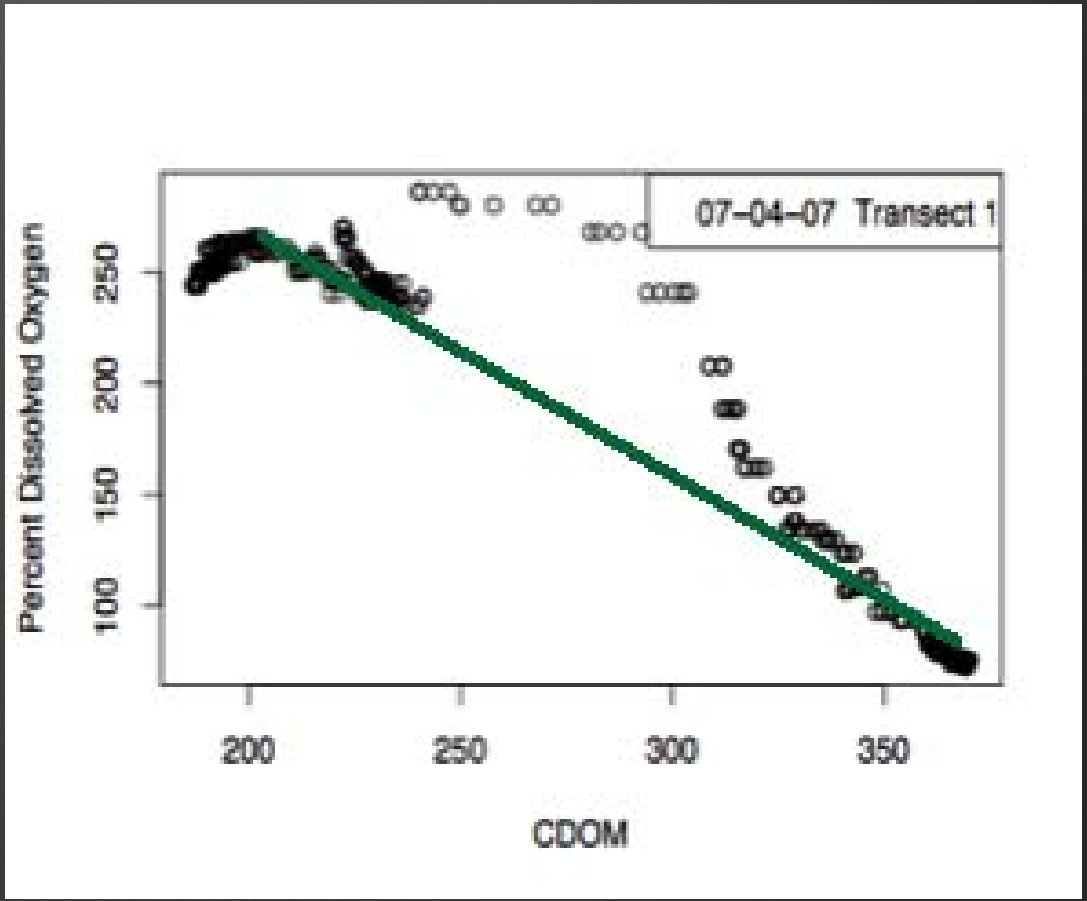
Exploratory data analysis

- R matrix – identify interesting relationships in the mixing zone



Transect results

- DO vs. CDOM
  - Above the dilution line
- In this case, results do not support the humic hypothesis



High-resolution transects

- Can use satellites and cameras
- Actual measurements in the lake
  - DO, CDOM, pH, pigments, temp, conductivity
- Previous technique – lots of pieces
- DataRon from Turner ($2k for one parameter)
- EXO sonde - $12-15k for multiple sensors

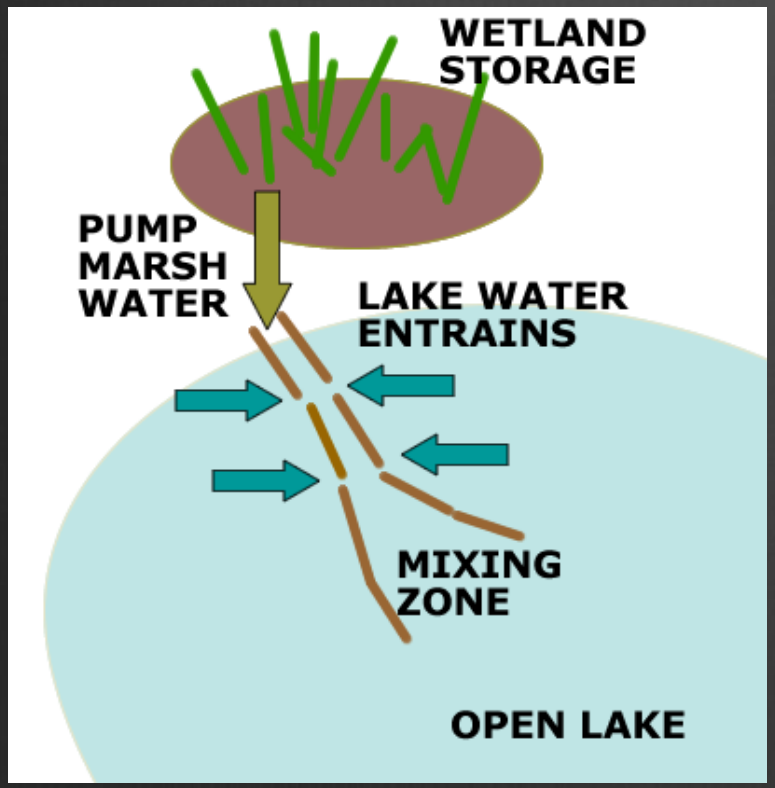
High-resolution transects

- Fallacy of the ROV
  - Expensive
  - Requires humans anyway
  - Misses the other “surprise” information

However they are shinny and new

Possible mitigation approaches

Controlled mixing
10% for 24 hrs



Example 2: temporary mixing

- Surface “scum” confers advantage
- Disruption of surface layer decreases this advantage temporarily
- Changes in weather might disrupt this
- On-demand mixing

Possible problems – just some

- Mitigation projects might be too small to actually have an effect.
- Projects may not fit with agency goals or operation procedures.
- Small scale mitigations don't actually add up to large scale benefits, i.e. don't contribute to the solution.
- Management and research/monitoring are not adequately linked.

Conclusions
We should:

- Restate our objectives for algae control in UKL and Agency Lake
- Consider a wider range of management approaches
- Look for mitigation tactics that contribute to the overall strategic goals
- Perform management activities as if they were experiments

References/attributions

NOAA HABs definition
EPA HABs definition

Norton, B. G. (2005). Sustainability: A philosophy of adaptive ecosystem management. Chicago, University of Chicago Press.

Images:
Sign 1
Sign 2
SAV
Leviathan
Bamboo Raft
Sailboat in bloom
Powerboat in bloom
Inflatable in Lake Erie

Thank you